



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/US93/03014 <b>(22) International Filing Date:</b> 7 April 1993 (07.04.93) <b>(30) Priority data:</b> 907,048 1 July 1992 (01.07.92) US <b>(71) Applicant:</b> CHURCH & DWIGHT COMPANY, INC. [US/US]; 469 North Harrison Street, Princeton, NJ 08543 (US). <b>(72) Inventors:</b> WINSTON, Anthony, E. ; 42 Tall Oaks Dr., East Brunswick, NJ 08816 (US). KIRSCHNER, Law- rence ; 33 Deer Path Dr., Flanders, NJ 07836 (US).		<b>(74) Agents:</b> DEPAOLI, George, A.; 2231 Crystal Drive, Suite 1103, Arlington, VA 22202 (US) et al.  <b>(81) Designated States:</b> AT, AU, BB, BG, BR, CA, CH, CZ, DE, DK, ES, FI, GB, HU, JP, KP, KR, LK, LU, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i>
<b>(54) Title:</b> PLANT GROWTH REGULATING COMPOSITIONS  <b>(57) Abstract</b>  <p>This invention provides dry blend and aqueous formulations which exhibit plant growth regulating activity when applied to seeds, plant cuttings or rooted plants for agricultural or horticultural purposes. An invention plant growth regulating composition contains a bicarbonate salt and a phytohormone ingredient. In a preferred embodiment, an invention composition additionally contains a plant growth stimulant ingredient such a a surfactant or a water-soluble polyhydroxylated organic compound.</p>		

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## PLANT GROWTH REGULATING COMPOSITIONS

### BACKGROUND OF THE INVENTION

Phytohormones are biologically active organic compounds which in minute quantities  
5 function to promote or modify plant growth such as root and bud formation.

Phytohormones are classified as auxin, cytokinin, gibberellin and abscisic acid types as relating to different plant growth regulating  
10 activities.

Auxins affect cell division and growth, and promote elongation of plant shoots and other specific growth effects.

Cytokinins affect the organization of  
15 dividing cells, and promote elongation of root cells.

Gibberellins promote the growth of seedlings, and have other specific activities of the auxin type.

20       Abscisisic acids exhibit abscission-accelerating activity. Abscisisic acid is utilized in somatic embryogenesis which employs tissue culture techniques for generating multiple embryos from donor plant tissue.

25       Important beneficial effects derive from the use of phytohormones as plant growth regulators in agricultural applications, which include

improved seed germination; promotion of rooting;  
increased resistance of plants to frost, fungal and  
insect attack; increased uptake of inorganic  
constituents from the soil; increased photosynthetic  
5 power; stabilization of chlorophyll; reduction in  
fertilizer requirements; increased crop yield;  
production of seedless fruits; herbicidal activity;  
and the like.

The development and utility of  
10 phytohormones are described in publications such as  
United States Patent Numbers 2,284,002; 3,051,723;  
3,320,281; 4,096,661; 4,156,684; 4,169,717;  
4,291,497; 4,411,684; 4,415,350; 4,519,163;  
4,957,866; 5,008,200; 5,017,491; 5,034,326; and  
15 references cited therein.

There is continuing interest in the  
development of new and improved plant growth  
regulating compositions for increasing the yield and  
quality of cultivated agricultural and horticultural  
20 plant life.

Accordingly, it is an object of this  
invention to provide an agrochemical composition  
which is a combination of inorganic and organic  
compounds exhibiting plant growth regulating  
25 activities.

It is another object of this invention to  
provide a dry particulate composition or an aqueous  
formulation which is a combination of components  
that includes a bicarbonate-containing inorganic

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salt ingredient which enhances the beneficial activity of a plant growth regulating ingredient in agricultural applications.

Other objects and advantages of the  
5 present invention shall become apparent from the accompanying description and examples.

DESCRIPTION OF THE INVENTION

One or more objects of the present invention are accomplished by the provision of a plant growth regulating composition which is a dry  
5 blend formulation comprising:

- (a) an inorganic salt ingredient selected from alkali metal and ammonium bicarbonates; and
- (b) an effective plant growth regulating  
10 quantity of a phytohormone ingredient.

The weight quantity of the phytohormone ingredient can vary in the range between about 20 parts per million and one weight percent, when  
15 the composition is to be employed directly without any dilution with an inert solid or liquid medium.

The weight quantity of the phytohormone ingredient can be in a higher concentration if a subsequent dilution is contemplated before usage.  
20 The concentration of phytohormone ingredient can be in the range of about 500 parts per million and five weight percent, and higher, prior to dilution with a solid or liquid medium.

The amount of plant growth ingredient in  
25 an invention composition depends upon the specific vegetation being treated, as well as upon the specific plant growth regulating ingredient and

formulation being employed, the method of applying the formulation, and the locus of treatment. Spray dilutions may be as low as a few parts per million.

The phytohormone ingredient can consist of one or more organic compounds which exhibit plant growth regulating activity, and are selected from known natural and synthetic auxins, cytokinins, gibberellins and abscisic acids.

Illustrative of phytohormones are 3-indolealkanoic acid; 2,4-dichlorophenoxyacetic acid; 4-chlorophenoxyacetic acid; 2-methyl-4-chlorophenoxyacetic acid; 2,4,5-trichlorophenoxyacetic acid; 2,3,5-triiodobenzoic acid; aminobenzoic acid; 1-naphthaleneacetic acid; 1-naphthaleneacetamide; 2-methyl-1-naphthaleneacetic acid; 2-methyl-1-naphthaleneacetamide; 1-naphthylethanesulfonic acid; phenyl indole-3-acetate; 4-chlorophenyl indole-3-butyrate; 4-chlorophenyl indole-3-acetate; 2,4,6-tribromophenyl indole-3-butyrate; phenyl indole-3-thioloacetate; 4-carbethoxy indole-3-butyrate; gibberellic acid; abscisic acid; 6-furfurylaminopurine (kinetin); 6-benzylaminopurine; methylhydroxymethylalkylaminopurine (zeatin); and the like.

The inorganic salt ingredient is selected from compounds which include sodium bicarbonate, potassium bicarbonate, lithium bicarbonate and ammonium bicarbonate. In a further embodiment, the

inorganic salt ingredient can include an additional compound selected from sodium carbonate, potassium carbonate, lithium carbonate and ammonium carbonate.

Illustrative of inorganic salt ingredients in a formulation are sodium, potassium, lithium or ammonium bicarbonate, or mixtures such as sodium bicarbonate and potassium bicarbonate; sodium bicarbonate and ammonium bicarbonate; potassium bicarbonate and ammonium bicarbonate; sodium bicarbonate, potassium bicarbonate and ammonium bicarbonate; sodium bicarbonate and potassium carbonate; potassium bicarbonate and potassium carbonate; and the like.

Multiple inorganic salt compounds can be utilized in a broad range of molar quantities relative to each other. The molar quantity of a carbonate salt compound normally is determined by pH control considerations when aqueous formulations are prepared. The content of a carbonate salt compound can be varied to control the pH at a desired level in the range of 7.5-12.

The ingredients in an invention plant growth regulating composition can be selected to include nitrogen, phosphorus and potassium elements, in a ratio that allows the composition to function as a fertilizer in addition to its function as a plant growth regulator, when applied to seeds, seedlings or cultivated crops.



An invention plant growth regulating composition can include one or more other biologically active ingredients, such as those which exhibit herbicidal, fungicidal or insecticidal activity.

One type of preferred plant growth regulating composition of the present invention is one which has a content of potassium bicarbonate and gibberellic acid. The gibberellic acid can be added in free acid form, or as an alkali metal salt. This preferred type of composition exhibits a high plant growth regulating activity when a minute quantity of gibberellic acid ingredient is utilized. The composition is utilized to promote the production of seedless fruit such as grape.

Another preferred plant growth regulating composition is one consisting of potassium bicarbonate in combination with 3-indolebutyric acid or 1-naphthaleneacetic acid or a mixture thereof. The composition is utilized to promote the rooting of plant cuttings.

Another preferred plant growth regulating composition is one consisting of sodium or potassium bicarbonate in combination with 2,4-dichlorophenoxyacetic acid or 2,4,5-trichlorophenoxyacetic acid or a mixture thereof. The composition exhibits enhanced herbicidal activity.

In another embodiment this invention provides a plant growth regulating composition which is a dry blend formulation comprising:

- 5 (a) an inorganic salt ingredient selected from alkali metal and ammonium bicarbonates;
- (b) an effective plant growth regulating quantity of a phytohormone ingredient; and
- 10 (c) a particulate inert carrier.

An inert carrier-diluted composition typically can contain between about 20-200 parts per million of phytohormone ingredient, and between about 5-1500 parts by weight of inorganic salt  
15 ingredient per weight part of phytohormone ingredient. For some applications such as the rooting of plant cuttings, the phytohormone content can range up to about one weight percent, and the inorganic salt content can range up to about  
20 20 weight percent, based on the composition weight.

An inert carrier-diluted composition can be in the form of dusting powders or granules. Granules can be formed by impregnating pellets of filler with the plant growth regulating composition  
25 ingredients, or by pelleting a dry blend plant growth regulating composition in admixture with a powdered inert carrier. Suitable inert carriers include bentonite, calcium carbonate, magnesia,

gypsum, kieselguhr, diatomaceous earth, zeolite, and the like.

In another embodiment this invention provides a plant growth regulating composition which is a dry blend formulation comprising:

- (a) an effective plant growth regulating quantity of a phytohormone ingredient;
- (b) an effective quantity of a plant growth stimulant ingredient; and
- (c) an inorganic salt ingredient selected from alkali metal and ammonium bicarbonates.

A plant growth regulating composition with a plant growth stimulant ingredient typically can contain between about 20-200 parts per million of phytohormone ingredient; and between about 10-100 parts by weight of plant growth stimulant ingredient, and between about 5-1500 parts by weight of inorganic salt ingredient, per weight part of phytohormone ingredient; and additionally contains a particulate inert carrier.

A plant growth stimulant ingredient is selected from one or more of organic compounds such as surfactants, and water-soluble organic compounds which are in solid form at a temperature below about 10°C and have a low vapor pressure at ambient temperatures.

A surfactant growth stimulant ingredient can be a cationic, anionic or nonionic type, or a mixture thereof. Suitable surfactants include cetyltrimethylammonium bromide; sodium lauryl sulfate; sodium dodecylbenzenesulfonate; ammonium lignosulfonate; condensation products of ethylene oxide with fatty alcohols, amines or alkylphenols; partial esters of fatty acids and hexitol anhydrides; and the like.

Water-soluble organic compounds having a low vapor pressure which can function as a plant growth stimulant ingredient include acetamide, acetylurea, alanine, aminoquanidine, aminopyridine, arabinose, benzenesulfonate salt, benzoate salt, citrate salt, cyclohexanol, dihydroxyacetone, dihydroxyacetone phosphate salt, dimethylurea, ethanolamine, ethylurea, ethylenedisulfonate salt, paraformaldehyde, fucose, glycerol, glycerol nitrate, glycerol phosphate salt, glycogen, glycolic aldehyde, glyoxal, hexamine, mannitol, fructose, glucose, hydroxyurea, lactose, maltose, maltodextrin, methyl glucoside, methylhydantoin, methylinositol, methylthiourea, methyluracil, methylurea, nitropentanediol, nitrourethane, pentaglycerol, phenylenediamine, polydextrose, ribose, semicarbazide, succinimide, sucrose, tetrahydroquinoline, tetrazine, thiourea, threonine, triaminobenzene, triazole, triethylphosphine oxide,

triethylenetetramine, trihydroxybenzene,  
trimethylurea, trioxane, urea, xylose, xylylene  
glycol,  $\beta$ -cyclodextrin, polyvinylpyrrolidone, sodium  
carboxymethylcellulose, polyoxyalkylene glycol,  
5 polyalkylene oxide, xanthan gum, guar gum, locust  
bean gum, gum acacia, gum tragacanth, alginate salt,  
potato agar, and the like.

The term "water-soluble" as employed  
herein refers to an organic compound which has a  
10 solubility of at least about one gram per 100 grams  
of water at 25°C.

The presence of a plant growth stimulant  
ingredient in an invention composition contributes  
several important benefits when a composition is  
15 used in an agricultural application.

A plant growth stimulant ingredient aids  
in increasing the yield and quality of cultivated  
plant life. A plant growth stimulant ingredient  
accelerates penetration of plant tissue cells,  
20 seeds, plant cuttings or rooted plants by a  
phytohormone ingredient. The penetration by the  
phytohormone is promoted with controlled efficacy  
when applied in combination with a plant growth  
stimulant ingredient. The accelerated penetration  
25 is in addition to that provided by the bicarbonate  
salt ingredient.

In a further embodiment this invention provides a plant growth regulating composition which is an aqueous medium having an ingredient content which comprises:

- 5                   (a) an inorganic salt ingredient selected from alkali metal and ammonium bicarbonates; and
- (b) an effective plant growth regulating quantity of a phytohormone
- 10                   ingredient.

The specific types and quantities of ingredients are similar to those employed in dry blend formulations. Preferably, an aqueous plant growth regulating composition contains one or more

15   plant growth stimulating organic compounds, such as a surfactant and/or a water-soluble polyhydroxy or polyoxyalkylene compound.

An important feature of a present invention plant growth regulating composition is the

20   inclusion of a bicarbonate salt ingredient. The bicarbonate salt ingredient exhibits fungicidal properties, and additionally the efficacy of the phytohormone ingredient is enhanced by the presence of the bicarbonate salt ingredient. A lesser

25   quantity of phytohormone ingredient then can be employed to achieve a desired degree of plant growth regulating control. The bicarbonate salt ingredient facilitates the penetration of the plant system by

the phytohormone, thereby accelerating and enhancing the plant growth regulating activity in a treated plant.

A present invention plant growth  
5 regulating composition can be formulated to exhibit little or no phytotoxicity, or to minimize the toxic effects of salt stress on plants by the inorganic salt ingredient.

An important feature of a preferred  
10 invention plant growth regulating composition is the inclusion of a plant growth stimulant agent as an essential ingredient. Migration and settling of solid ingredients is minimized, and a dry blend formulation has a more uniformly distributed content  
15 because of the presence of the plant growth stimulant ingredient. An aqueous plant growth regulating formulation has exceptional long term stability, without phase separation and precipitation of solids, because of the stimulant  
20 ingredient.

As a further advantage, a preferred invention aqueous formulation has improved spreadability and adhesiveness when applied to plant foliage, and resists post-application ingredient  
25 drift. An applied formulation also exhibits humectant properties on coated foliage, and increased plant growth efficacy because of the presence of a plant growth stimulant ingredient.

The following examples are further illustrative of the present invention. The components and specific ingredients are presented as being typical, and various modifications can be  
5 derived in view of the foregoing disclosure within the scope of the invention.



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EXAMPLE I

This Example illustrates the preparation of a plant growth regulating dusting powder in accordance with the present invention.

5           The following ingredients are provided in the indicated proportions:

		<u>Parts</u>
	NaHCO <sub>3</sub>	5
	KHCO <sub>3</sub>	5
10	3-indoleacetic acid	70 ppm
	talc	90

The active ingredients are blended with the talc and milled to a dry pulverulent composition having a particle size less than 0.5 micron.

15           The powder is applied to apple trees during the blossoming period. The number of set fruits and apple yield is increased as compared to untreated control trees.

20           The number of set fruits and apple yield is higher for a composition having a content of NaHCO<sub>3</sub>/KHCO<sub>3</sub> as compared to a composition which does not contain the inorganic salt compounds.

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EXAMPLE II

This Example illustrates the preparation of a plant growth regulating composition in the form of a wettable powder formulation.

5           The following ingredients are provided in the indicated proportions:

	<u>Parts</u>
NaHCO <sub>3</sub>	10
KHCO <sub>3</sub>	10
10    kinetin	5x10 <sup>-3</sup>
2,4-dichlorophenoxyacetic acid	6x10 <sup>-3</sup>
sodium lignosulfonate	2
kaolin	60

15           The active ingredients are blended with the sodium lignosulfonate and kaolin ingredients, and the blend is suspended in water to provide an aqueous formulation which contains about 50 ppm of kinetin and 60 ppm of 2,4-dichlorophenoxyacetic acid.

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EXAMPLE III

This Example illustrates the preparation of fungicide-plant growth regulating composition tablets which rapidly disintegrate and disperse in  
5 water.

		<u>Parts</u>
	Captan	10
	NaHCO <sub>3</sub>	40
	zeatin	600 ppm
10	abscisic acid	1000 ppm
	citric acid	15
	Lomar PWA 10 <sup>(1)</sup>	10
	polyethylene glycol (M.W. 4000)	10
15	sodium lignosulfonate	2

The active ingredients are blended with the citric acid, Lomar PWA 10, polyethylene glycol and sodium lignosulfonate ingredients, and the blend is formed into tablets which disintegrate and  
20 disperse in water within about six minutes at 25°C, to form an aqueous medium which contains 30 ppm of zeatin and 50 ppm of abscisic acid.

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(<sup>1</sup>) sodium salt of alkylarylsulfonate condensation  
25 product (Jacques Wolf & Co.)

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EXAMPLE IV

This Example illustrates the preparation of an acaricide-plant growth regulator-fertilizer composition for application to cultivated fields.

5		<u>Parts</u>
	melamine	40
	urea	30
	potassium glycerol phosphate	20
10	tetradifon	5
	KHCO <sub>3</sub>	15
	gibberellic acid	150 ppm

The ingredients are blended, and milled to a 80-100 mesh powder. Granules are prepared by tumbling the powdered blend, spraying added water to form tacky solids, and then drying the granulated product.

EXAMPLE V

This Example illustrates the preparation of an aqueous fertilizer-plant growth regulator formulation.

5		<u>Parts</u>
	urea	40
	superphosphate	40
	KHCO <sub>3</sub>	15
	K <sub>2</sub> CO <sub>3</sub>	5
10	sorbitol	30
	gibberellic acid	500 ppm
	kinetin	300 ppm
	p-aminobenzoic acid	300 ppm

The ingredients are dissolved in water to form a solution which contains 50 ppm of gibberellic acid, 30 ppm of kinetin and 30 ppm of p-aminobenzoic acid.

The aqueous formulation is sprayed on tomato plants during the blossoming and fruit-setting period. The yield of tomatoes is increased as compared with untreated control plants. The yield is increased less if either the potassium bicarbonate or sorbitol ingredient is not included in the formulation.

The sorbitol enhances the compatibility between the inorganic and organic ingredients, and accelerates the penetration of the active ingredients into the plant structure.

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EXAMPLE VI

This Example illustrates the preparation of a concentrated herbicidal composition in the form of a water-soluble powder.

5		<u>Parts</u>
	NaHCO <sub>3</sub>	97.48
	2,4,5-trichlorophenoxy- acetic acid	2.00
	potassium oleate	0.50
10	butylated hydroxytoluene	0.02

The ingredients are blended to form a dry powder composition. The powder is dissolved in water to provide an aqueous solution having a 200 ppm concentration of 2,4,5-trichlorophenoxy-  
15 acetic acid which has utility as a herbicidal spray.

EXAMPLE VII

This Example illustrates the preparation of a concentrated plant growth regulating composition for application in the production of seedless fruit.

	<u>Parts</u>
KHCO <sub>3</sub>	95
gibberellic acid	5

The ingredients are blended to form a dry powder composition. The powder is dissolved in water to provide an aqueous solution which has a 150 ppm concentration of gibberellic acid.

The solution is sprayed on the flowers of grape or other fruit before fertilization to promote seedless fruit formation.

EXAMPLE VIII

This Example illustrates the preparation of a phytohormone composition with an enhanced activity for rooting of plant cuttings.

5		<u>Parts</u>
	KHCO <sub>3</sub>	10.0
	3-indolebutyric acid	0.2
	1-naphthaleneacetic acid	0.2
	kaolin	89.6

10           The ingredients are blended to provide a dry powder composition. The ends of plant cuttings are moistened, and then dipped into the dry powder. The bicarbonate salt ingredient accelerates the penetration of the plant stems with the phytohormone  
15 ingredients.

          In comparison with control plant cuttings, the treated plant cuttings exhibit earlier and more extensive root growth. The treated plant cuttings also have less fungal infestation than the control  
20 plant cuttings.



WHAT IS CLAIMED IS:

1. A plant growth regulating composition which is a dry blend formulation comprising:

- 5 (a) an inorganic salt ingredient selected from alkali metal and ammonium bicarbonates; and
- (b) an effective plant growth regulating quantity of a phytohormone ingredient.

10 2. A plant growth regulating composition in accordance with claim 1 wherein the quantity of phytohormone ingredient is between about 20 parts per million and one weight percent.

15 3. A plant growth regulating composition in accordance with claim 1 wherein the quantity of phytohormone ingredient is between about 500 parts per million and five weight percent.

20 4. A plant growth regulating composition in accordance with claim 1 wherein the phytohormone ingredient has an auxin content.

5. A plant growth regulating composition in accordance with claim 1 wherein the phytohormone ingredient has a cytokinin content.

6. A plant growth regulating composition in accordance with claim 1 wherein the phytohormone ingredient has a gibberellin content.

5 7. A plant growth regulating composition in accordance with claim 1 wherein the phytohormone ingredient has an abscisic acid content.

8. A plant growth regulating composition in accordance with claim 1 wherein the inorganic salt ingredient additionally contains alkali metal  
10 or ammonium carbonate.

9. A plant growth regulating composition in accordance with claim 1 wherein the inorganic salt ingredient contains at least two different alkali metal or ammonium bicarbonate compounds.

15 10. A plant growth regulating composition in accordance with claim 1 which has a content of a phosphorus-containing ingredient, and the composition ingredients have a fertilizer formulation ratio of nitrogen, phosphorus and  
20 potassium.

11. A plant growth regulating composition in accordance with claim 1 wherein the inorganic salt ingredient is potassium bicarbonate, and the phytohormone ingredient is gibberellic acid.

12. A plant growth regulating composition which is a dry blend formulation comprising:

- 5 (a) an inorganic salt ingredient selected from alkali metal and ammonium bicarbonates;
- (b) an effective plant growth regulating quantity of a phytohormone ingredient; and
- (c) a particulate inert carrier.

10 13. A plant growth regulating composition in accordance with claim 12 wherein the weight quantity of phytohormone ingredient is between about 20-200 parts per million, and the quantity of inorganic salt ingredient is between about  
15 5-1500 parts by weight per part of phytohormone ingredient.

14. A plant growth regulating composition in accordance with claim 12 wherein the phytohormone ingredient has an auxin content.

20 15. A plant growth regulating composition in accordance with claim 12 wherein the phytohormone ingredient has a cytokinin content.

16. A plant growth regulating composition in accordance with claim 12 wherein the phytohormone  
25 ingredient has a gibberellin content.

17. A plant growth regulating composition in accordance with claim 12 wherein the phytohormone ingredient has an abscisic acid content.

5 18. A plant growth regulating composition in accordance with claim 12 wherein the inorganic salt ingredient additionally contains alkali metal or ammonium carbonate.

10 19. A plant growth regulating composition in accordance with claim 12 wherein the inorganic salt ingredient contains at least two different alkali metal or ammonium bicarbonate compounds.

20. A plant growth regulating composition which is a dry blend formulation comprising:

- 15 (a) an effective plant growth regulating quantity of a phytohormone ingredient;
- (b) an effective quantity of a plant growth stimulant ingredient; and
- 20 (c) an inorganic salt ingredient selected from alkali metal and ammonium bicarbonates.

21. A plant growth regulating composition in accordance with claim 20 wherein the weight quantity of phytohormone ingredient is between about

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20-200 parts per million; the quantity of plant growth stimulant ingredient is between about 10-100 parts by weight, and the quantity of inorganic salt ingredient is between about  
5 5-1500 parts by weight, per part of phytohormone ingredient; and the composition additionally contains a particulate inert carrier.

22. A plant growth regulating composition in accordance with claim 20 wherein the phytohormone  
10 ingredient has an auxin content.

23. A plant growth regulating composition in accordance with claim 20 wherein the phytohormone ingredient has a cytokinin content.

24. A plant growth regulating composition  
15 in accordance with claim 20 wherein the phytohormone ingredient has a gibberellin content.

25. A plant growth regulating composition in accordance with claim 20 wherein the phytohormone ingredient has an abscisic acid content.

20 26. A plant growth regulating composition in accordance with claim 20 wherein the plant growth stimulant ingredient is a surfactant.

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27. A plant growth regulating composition in accordance with claim 20 wherein the plant growth stimulant ingredient is a water-soluble organic compound which is in solid form at a temperature  
5 below about 10°C.

28. A plant growth regulating composition in accordance with claim 20 wherein the inorganic salt ingredient additionally contains alkali metal or ammonium carbonate.

10 29. A plant growth regulating composition in accordance with claim 20 wherein the inorganic salt ingredient contains at least two different alkali metal or ammonium bicarbonate compounds.

15 30. A plant growth regulating composition in accordance with claim 20 which has a content of a phosphorus-containing ingredient, and the composition ingredients have a fertilizer formulation ratio of nitrogen, phosphorus and potassium.

20 31. A plant growth regulating composition which is an aqueous medium having an ingredient content which comprises:

- (a) an inorganic salt ingredient selected from alkali metal and ammonium bicarbonates; and
- (2) an effective plant growth regulating quantity of a phytohormone ingredient.

32. A plant growth regulating composition in accordance with claim 31 wherein the quantity of phytohormone ingredient is between about 20 parts per million and one weight percent.

33. A plant growth regulating composition in accordance with claim 31 wherein the quantity of phytohormone ingredient is between about 500 parts per million and five weight percent.

34. A plant growth regulating composition in accordance with claim 31 wherein the phytohormone ingredient has an auxin content.

35. A plant growth regulating composition in accordance with claim 31 wherein the phytohormone ingredient has a cytokinin content.

36. A plant growth regulating composition in accordance with claim 31 wherein the phytohormone ingredient has a gibberellin content.

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37. A plant growth regulating composition in accordance with claim 31 wherein the phytohormone ingredient has a abscisic acid content.

5 38. A plant growth regulating composition in accordance with claim 31 wherein the inorganic salt ingredient additionally contains alkali metal or ammonium carbonate.

10 39. A plant growth regulating composition in accordance with claim 31 wherein the inorganic salt ingredient contains at least two different alkali metal or ammonium bicarbonate compounds.

15 40. A plant growth regulating composition in accordance with claim 31 which has a content of a phosphorus-containing ingredient, and the composition ingredients have a fertilizer formulation ratio of nitrogen, phosphorus and potassium.

20 41. A plant growth regulating composition which is an aqueous medium having an ingredient content which comprises:

- (a) an effective plant growth regulating quantity of a phytohormone ingredient;



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- (b) an effective quantity of a plant growth stimulant ingredient; and
- (c) an inorganic salt ingredient selected from alkali metal and ammonium bicarbonates.

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42. A plant growth regulating composition in accordance with claim 41 wherein the weight quantity of phytohormone ingredient is between about 20-200 parts per million; and the quantity of plant growth stimulant ingredient is between about 10-100 parts by weight, and the quantity of inorganic salt ingredient is between about 5-1500 parts by weight, per part of phytohormone ingredient.

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43. A plant growth regulating composition in accordance with claim 41 wherein the phytohormone ingredient has an auxin content.

44. A plant growth regulating composition in accordance with claim 41 wherein the phytohormone ingredient has a cytokinin content.

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45. A plant growth regulating composition in accordance with claim 41 wherein the phytohormone ingredient has a gibberellin content.

46. A plant growth regulating composition in accordance with claim 41 wherein the phytohormone ingredient has an abscisic acid content.

5 47. A plant growth regulating composition in accordance with claim 41 wherein the plant growth stimulant ingredient is a surfactant.

10 48. A plant growth regulating composition in accordance with claim 41 wherein the plant growth stimulant ingredient is a water-soluble organic compound which is in solid form at a temperature below about 10°C.

## INTERNATIONAL SEARCH REPORT

 International application No.  
 PCT/US93/03014
**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(5) : A01N 43/38

US CL : 504/284

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 71/DIG 1; 504/284

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Please See Extra Sheet.

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Chemical Abstracts, Volume 116, No. 17, 1991 "Plant Growth Regulator Formulations Containing Surfactants, Carbonates and Acids for Paddy", Otsubo, Toshiro et al. Abs. No. 168354f, See Abs.	20-22, 26-27, 29, 41-43, 47, 48
Y	US, A, 4,047,924 (Parry et al.) 13 September 1977, See entire document.	1-4, 12-14, 19, 20-22, 26-27, 29, 41-43, 47, 48
Y	US, A, 4,812,162 (Anthony et al.) 14 March 1989, See col. 9, col. 5	1-4, 12-14, 19, 20, 22-26, 27, 29, 41-43, 47-48

☒ Further documents are listed in the continuation of Box C.
 ☐ See patent family annex.

* Special categories of cited documents:	*T	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be part of particular relevance	*X*	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	*Y*	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*-&*	document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means		
*P* document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 24 JUNE 1993	Date of mailing of the international search report <b>03 AUG 1993</b>
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. NOT APPLICABLE	Authorized officer DEBORAH LAMBKIN Telephone No. (703) 308-1235

## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US93/03014

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, A, 2,265,159 (GRETHER) See col. 2, 09 December 1941 See col. 2, lines 55.	1-4, 12-14, 19, 20-22
A	US, A, 2,229,948 (GOLDSBORO) 28 January 1941, See entire document.	1-4, 12-14, 19, 20-22
Y	US, A, 4,130,413 (HANDTE) 19 December 1978, See entire document.	1-4, 12-14, 19, 20-22, 31-34, 39
Y	US, A, 4,806,143 (Marumo et al.) 21 February 1989, See entire document.	1-4, 12-14, 19, 31-34, 39
Y	JP, B, 2007-438 (Kumiai Chem. Ind. KK) 20 January 1977, See Abstract.	1-4, 12-14, 19, 31-34, 39
Y	JP, B 8020-791, (Suzuki S) 07 February 1983, See Abstract.	1-4, 12-14, 19, 31-34, 39
Y	UP, B, 8035102 (Kaken Chem. KK), 03 January 1983, See Abstract.	1-4, 12-14, 19, 31-34, 39

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US93/03014

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:  
(Telephone Practice)  
Please See Extra Sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☒ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:  
1-4, 9, 12-14, 19, 31-34, 39 and 20-22, 26-27, 29, 41-43, 47, 48
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US93/03014

## B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

STN > -CA, LREG, REG, BIOSIS

DIALOG

APS

AUXIN, INDOLEACETIC ACID, Na, K, NH<sub>4</sub>-bicarbonate, sodium lignosulfonate

## BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING

This ISA found multiple inventions as follows:

This application as filed is drawn to multiple inventions which do not conform to any of the different categories as set forth in PCT Rule 13.2(i)-(iii) or 37 CFR 1.475(b), (1) or (2) and not so linked to form a single general inventive concept. Thus, there is a lack of unity under PCT Rule 13.

The Groups are:

- I. Claims 1-4, 9, 12-14, 19, 31-34 and 39, drawn to two component auxin compositions.
- II. Claims 1-3, 5, 12, 13, 15, 19, 31-33, 35 and 39, drawn to two component cytokinin compositions.
- III. Claims 1-3, 6, 11-13, 16, 19, 31-33, 36 and 39, drawn to two component gibberellin compositions.
- IV. Claims 1-3, 7, 12, 13, 17, 19, 31-33, 37 and 39, drawn to two component abscisic acid compositions.
- V. Claims 1-3, 8, 12, 13, 18, 19, 31-33, 38 and 39, drawn to two component plus carbonates.
- VI. Claims 1-3, 12, 13, 19, 31-33, 39 and 40, drawn to two component plus NPK fertilizers.
- VII. Claims 20, 21, 22, 26, 27, 29, 41-43, 47 and 48, drawn to three component auxin compositions.
- VIII. Claims 20, 21, 23, 26, 27, 29, 41, 42, 44, 47 and 48, drawn to three component cytokinin compositions.
- IX. Claims 20, 21, 24, 26, 27, 29, 41, 42, 45, 47 and 49, drawn to three component gibberellin compositions.
- X. Claims 20, 21, 25, 26, 27, 29, 41, 42, 46, 47 and 48, drawn to three component abscisic acid compositions.
- XI. Claims 20, 21, 28, 26, 27, 29, 41, 42, 47 and 48, drawn to three component plus carbonates.
- XII. Claims 20, 21, 26, 27, 29, 30, 41, 42, 47 and 48, drawn to three component plus NPK fertilizers.